

The efficacy of two household cleaning and disinfecting agents on Lentil (*Lens culinaris Medik*) and Faba bean (*Vicia faba*) seed germination

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Abstract

A germination test of *Vicia faba* and *Lens culinaris* seeds under the effect of bleach and vinegar was conducted for seven days, and the observations were recorded daily. The completely randomized design (CRD) was used to examine the germination with three replicates at the lab conditions. Six germination parameters were measured, including germination percentage (GP), germination index (GI), mean germination time (MGT), mean germination rate (MGR), vigour index (VI), plus the fresh weight (FW) and dry weight (DW) of *Vicia faba* and *Lens culinaris* seeds. As a legume crop seeds model, the efficacy of four treatment levels from 0.005% to 0.5% of bleach and vinegar on the germination was tested. A chemical analysis was performed using the ion chromatography (IC) to evaluate the effect of chloride and acetate anions uptake on the seedling germination in addition to other essential nutrients.

Keywords

Sodium hypochlorite, Vinegar, Seed germination, Legume crop seeds, Inhibition

1. Introduction

The demand for household cleaning and disinfecting agents during the COVID-19 pandemic has been increased especially, bleach, vinegar, and ethanol due to the widespread pandemic. These agents are used as disinfectant and antimicrobial, in addition to several other applications. Bleach, as a recommended household sanitizer by the World Health Organization (WHO), is used even today as in a diluted concentration between 5000 ppm (0.5%) to 500 ppm (0.05%). To cover the global increase in demand for household sanitizers, country governments (especially developing countries) might resort to prepare a mass production of household sanitizers for domestic consumption, as a possible precaution against the recurrence of a similar pandemic. People nowadays are obsessed with excessive use of disinfectants, particularly the hypochlorite bleach and vinegar, before it ended up throwing residue into the sewer and then into the groundwater (especially in the countryside), which considered as essential drinking water and irrigation sources beside surface waters (Figure 1). In the current study, two legume crop seeds (Lentil and Faba bean) were tested for germination parameters under the effect of diluted treatments of household sanitizers. This work aimed to examine if there is any potential inhibition of lentil and faba bean seeds germination occurring as a result of applying different concentrations of hypochlorite bleach and vinegar.

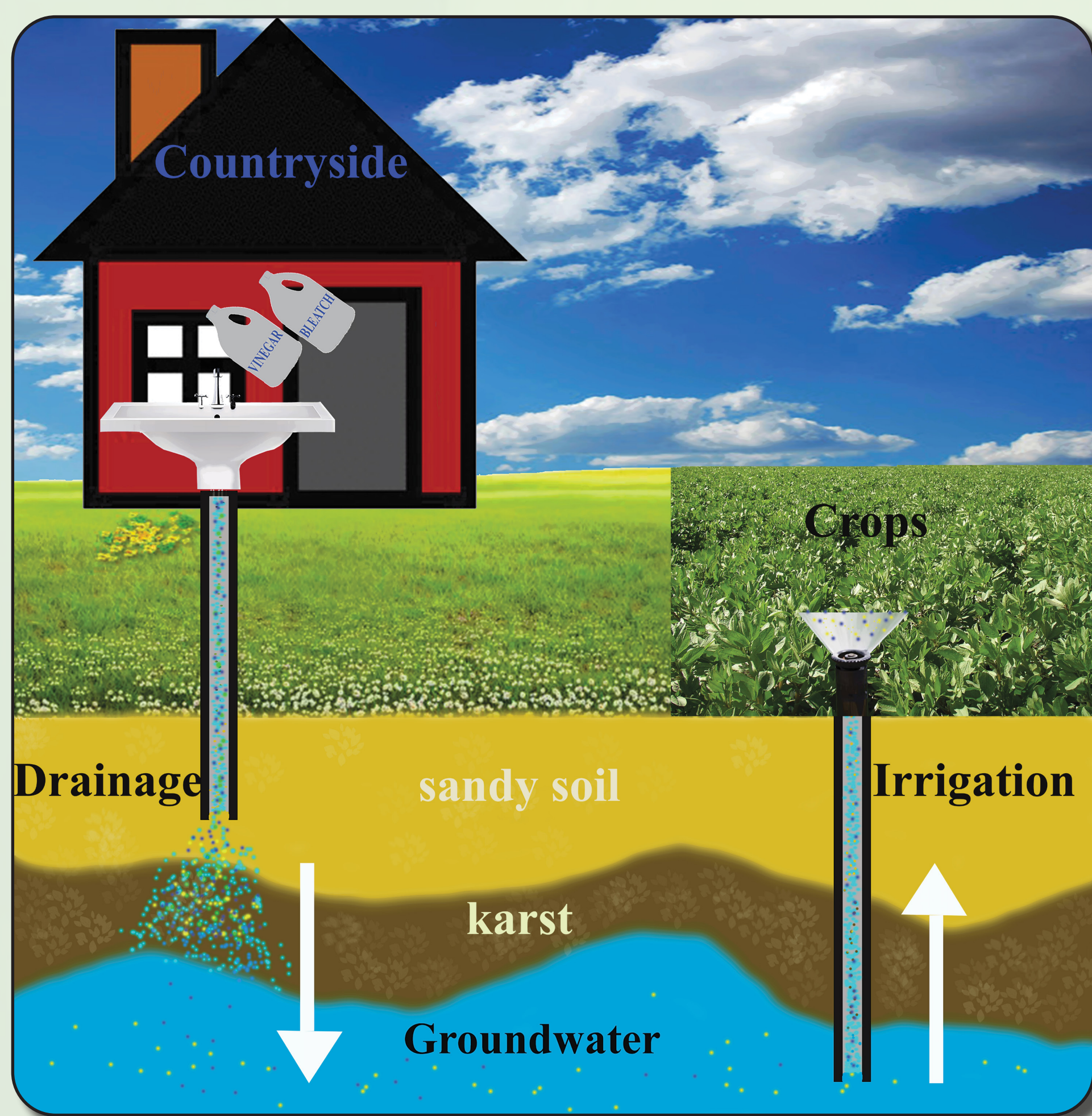


Figure 1. cycle of bleach and vinegar residue into the sewer and then into the groundwater.

2. Materials and Methods

Two crop seeds (Lentil and Faba bean) were collected from Doha, Qatar's local market. Healthy seeds were selected and disinfected by soaking in bleach solution 10% for two minutes, followed by rinsing three times with sterilized distilled water before the treatment procedures. 5% Hypochlorite bleach and 5% white vinegar treatment solutions were diluted to 0.5%, 0.1%, 0.05%, and 0.005% concentrations in addition to the control. The dilutions were carried on by dividing the initial concentration% multiplied by initial volume (mL) by the Final volume (mL). The final concentration% (active ingredients) is equivalent to the (v/v) concentration%. Ten sterilized seeds were transferred into each Petri dish with a sterilized filter paper as an independent replicate (Figure 2). The chloride (Cl^-) and acetate [CH_3COO^-] anions, in addition to phosphate, sulfate, sodium, ammonium, potassium, calcium, and magnesium, were analyzed by the ion chromatography (IC) method.

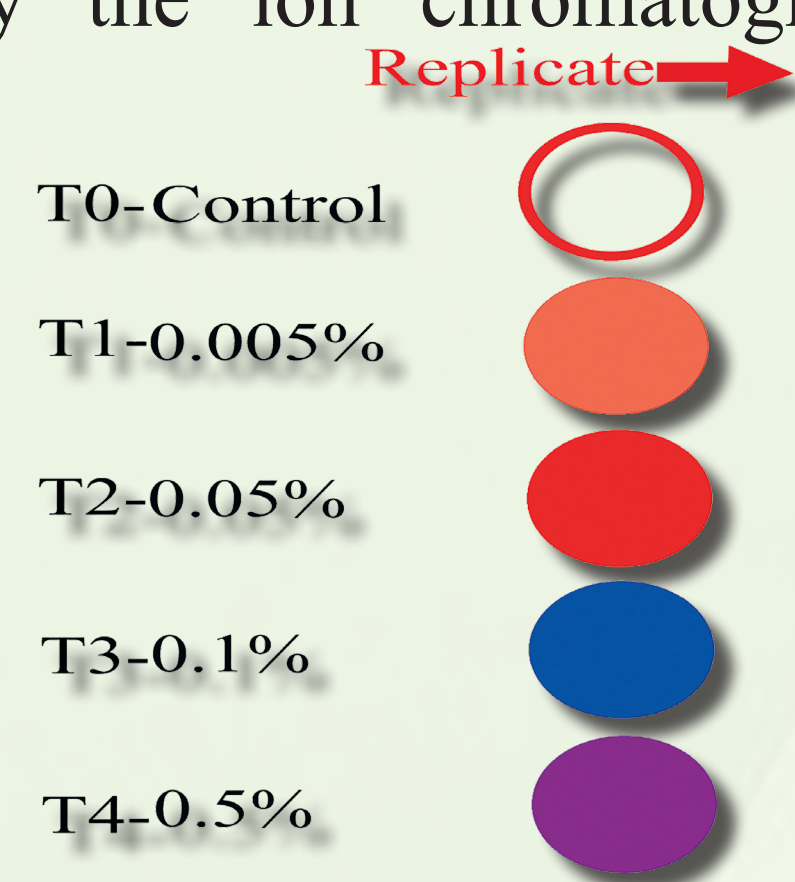


Figure 2: The experiment layout using five concentrations of two types of bleaches. Treatments were arranged in a completely randomized design (CRD) with three replicates.

3. Results

The chemical analysis of the up taking active ingredients was corroborated the germination outputs. The chloride, sodium, and acetate ions concentrations were increased with increasing the treatment level. Other essential nutrients concentrations were reduced (Figure 3). A significant inhibition in seedling growth was observed with increasing the treatment concentration. The maximum inhibition was recorded for both seeds at 0.5%, followed by 0.1% levels, while a positive effect was represented with the lower concentrations (Figure 4). Table 1 represents the correlation between GP on a side, and GI, MGT, MGR, CV_t , and VI in lentil and faba bean, on the other side. The GP variation between treatments was measured using a one-way ANOVA test at 95% Confidence interval (Table 2).

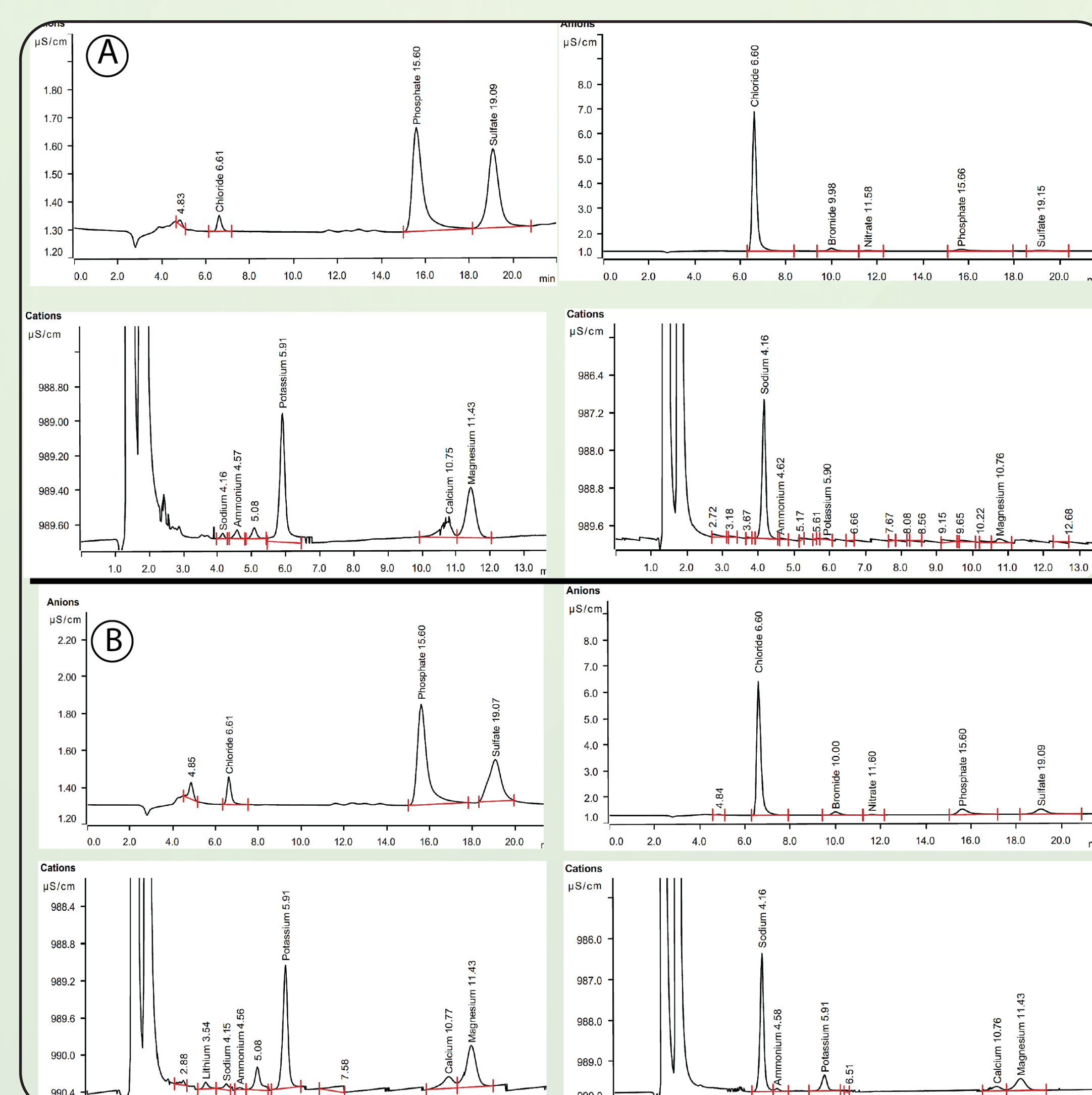


Figure 3. chromatogram of anions and cations that accumulated into seedling during the germination of Faba bean, (a) and Lentil (b) in the control sample and the higher level of treatment (0.5%).

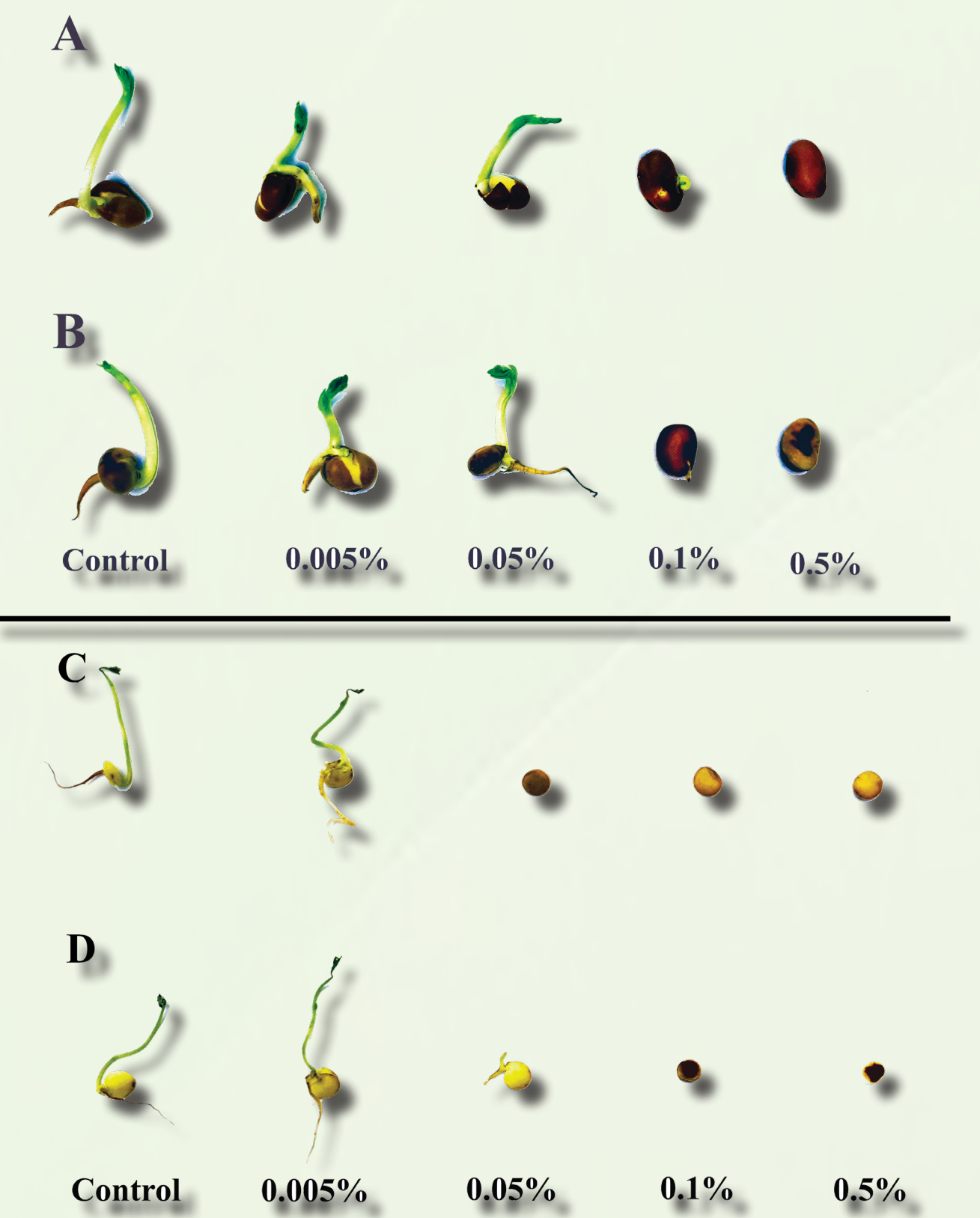


Figure 4. Lentil (*Lens culinaris Medik*) and Faba bean (*Vicia faba*) under the effect of different treatments, (A) Faba bean under different vinegar treatments, (B) Faba bean under different bleach concentrations. (C) lentil with vinegar treatments, and (D) lentil with different bleach treatments.

Correlations		<i>Lens Culinaris</i>		<i>Vicia faba</i>	
		bleach	vinegar	bleach	vinegar
GI	Pearson Correlation	0.910*	0.952*	0.875*	0.907*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
MGT	Pearson Correlation	0.667*	0.933*	0.510*	0.449
	Sig. (2-tailed)	0.007	0.000	0.052	0.093
MGR	Pearson Correlation	0.872*	0.905*	0.924*	0.899*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
CV_t	Pearson Correlation	0.676*	0.917*	0.666*	0.623*
	Sig. (2-tailed)	0.006	0.000	0.007	0.013
VI	Pearson Correlation	0.601*	0.867*	0.618*	0.798*
	Sig. (2-tailed)	0.018	0.000	0.014	0.000

*Correlation is significant at the 0.01 level (2-tailed).

Table 1: Germination parameters of *Lens culinaris Medik* and *Vicia faba* under the effect of bleach and vinegar treatments (df=4) with three replicates.

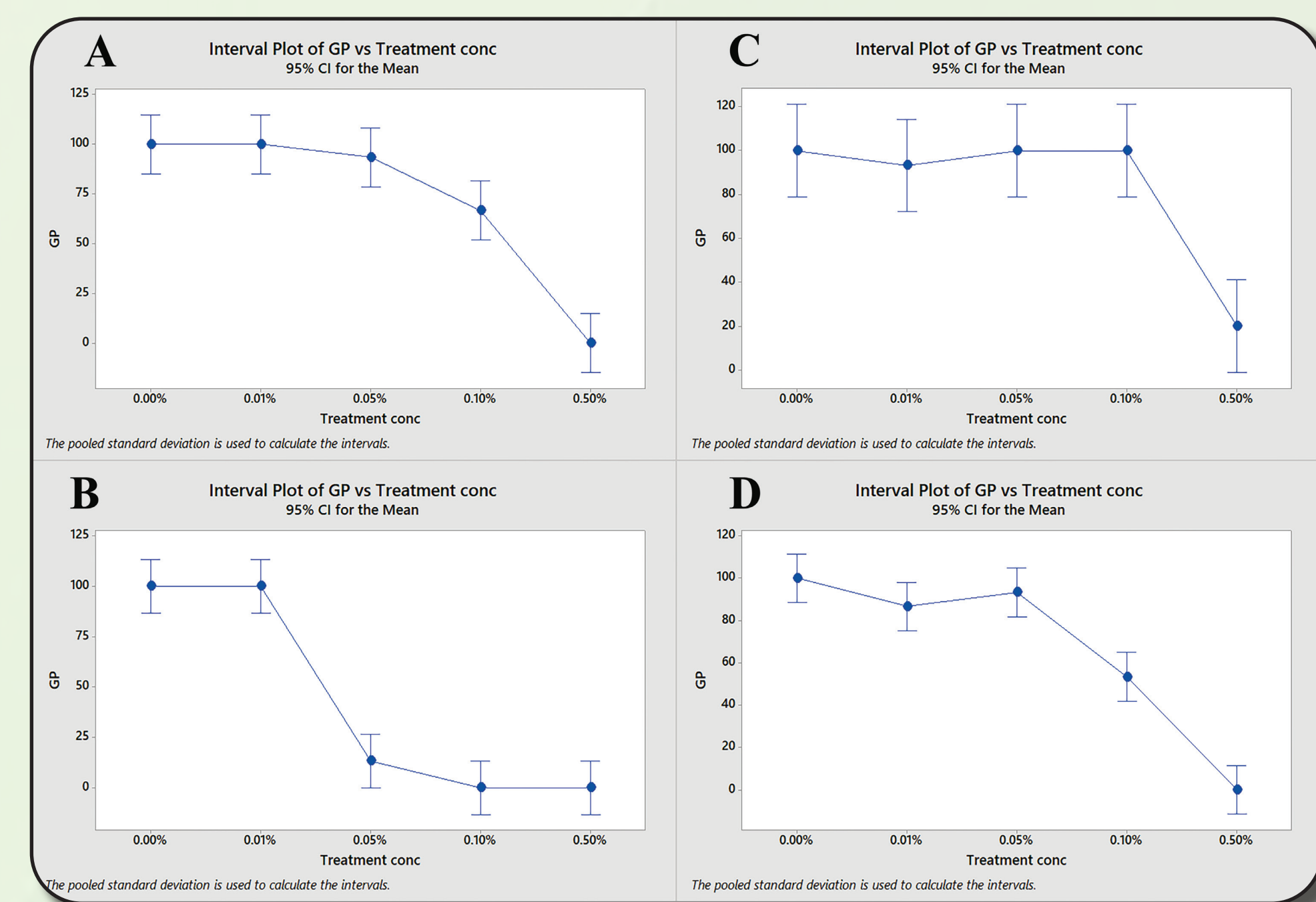


Figure 5. Interval Plot of the mean Germination Percentage (GP) of Lentil with bleach treatments (a), Lentil with vinegar treatments (b), Faba bean with bleach treatments (c), and Faba bean with vinegar treatments (d).

Crop seed	Sanitizers	Germination parameter	One-way ANOVA		
			SOV	DF	MS
<i>Lens Culinaris</i>	Bleach	Germination percentage (GP)	Between Groups	4	5426.667**
			Within Groups	10	133.333
	Vinegar	Germination percentage (GP)	Between Groups	4	15.644**
			Within Groups	10	2.364
<i>Vicia faba</i>	Bleach	Germination percentage (GP)	Between Groups	4	8306.667**
			Within Groups	10	106.667
	Vinegar	Germination percentage (GP)	Between Groups	4	23.123**
			Within Groups	10	1.180

** Highly significant differences at a confidence interval of $P \leq 0.01$.

Table 2: One-way ANOVA test for Germination percentage (GP) coupled with germination index (GI) of *Lens Culinaris* and *Vicia faba* seeds treated with two commercial Sanitizers (bleach and vinegar).

Acknowledgments

The authors thank Prof. Hamad Al-Kuwari, Director of the ESC, for providing all facilities to carry out this work. We acknowledge the help of Ms Hajer Alnaimi provided while conducting the experiments. The authors acknowledge the Central Laboratories Unit, Qatar University, for assistance in the chemical analysis using ion chromatography. Special thanks to Ms Ghada M.M. Mahdy for her help.